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LARVAL DISPERSAL OF THE WEED BIOLOGICAL CONTROL AGENT *OXYOPS VITIOSA* (COLEOPTERA: CURCULIONIDAE)

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The Australian tree *Melaleuca quinquenervia* (Cav.) S. T. Blake (Myrtales: Myrtaceae) was introduced into Florida in the late 1800s, where it has naturalized and proven to be a superior competitor to most native vegetation. Florida *M. quinquenervia* wetland forests typically form dense monocultures with continuous upper canopies and low species diversity (Rayamajhi et al. 2009). *M. quinquenervia* trees can exceed 30 m in height and tree architecture in dense stands is characterized by straight vertical trunks topped by canopies restricted to the uppermost portions of the tree. *Oxyops vitiosa* Pascoe (Coleoptera: Curculionidae) is a biological control agent of this exotic weed (Center et al. 2000). Weevil larvae are specialized defoliators of *M. quinquenervia* foliage, consuming only expanding leaves at branch apices (Pratt et al. 2004). Larvae exude a sticky orange secretion that covers the integument (Wheeler et al. 2002). This secretion is often deposited on plant surfaces where immatures have crawled, leaving a trail. Larvae complete 5 instars before seeking pupation sites in the soil. When considering the heights of their host plants, we questioned how *O. vitisoa* larvae disperse from their feeding sites in the upper portions of the canopy to pupation substrates on the forest floor.

Two methods were used to investigate this question. The first involved direct observation of the forest floor and tree trunks for dispersing *O. vitiosa* larvae during the winter mo when larval densities are highest. Observations were made at 2 long-term *M. quinquenervia* research sites in Florida, one near Lake Okeechobee (N 26.784° W -80.950°) and the other along the Everglades buffer strip (N 26.050° W -80.433°). Both sites were dominated by large *M. quinquenervia* trees growing in organic soils covered with thick layers of leaf litter. A 2 h search was made during the last wk of Jan of both 2001 and 2002 by haphazardly reviewing stands for larvae moving down tree trunks or falling from the canopies. In addition, observers inspected trunks for dispersing larvae or trails of yellow secretions deposited by larvae while migrating downwards. These survey efforts resulted in no evidence of larval dispersal via this mode. Similarly, no direct observations were made of larvae dropping from *M. quinquenervia* canopies. By following the sound of objects striking the ground, however, observers were occasionally able to locate fifth instars on the forest floor at both sites; no other larval stage were observed on the forest floor.

While these data provide support for the hypothesis that larvae freefall from canopies to forest floors, an alternative explanation for this phenomenon may be that 5th instar larvae are disproportionately dislodged from the canopy and subsequently recorded by observers. Therefore, a second method was employed in Feb 2003 that involved tracking larval dispersal in a more easily monitored environment. A 10 × 10 m area was covered with a polyethelene plastic sheet that was staked to the ground. Five 2-m tall potted *M. quinquenervia* trees were placed on top of the plastic sheeting and arranged to maximize spacing between individual trees in order to eliminate any contact among their canopies. Ten late instar *O. vitiosa* larvae were placed in the canopies of each tree. Immediately thereafter, the basal 10 cm of each tree trunk was coated with a layer of sticky material (Tanglefoot®) applied from an aerosol dispenser. Similarly, the sticky material was also applied to the surface of the plastic in a 2 m radius around each tree. Searches for larvae trapped on the sticky barrier at tree bases or in the sticky coating on the plastic commenced 24 h later and were conducted twice daily (at 8 a.m. and 5 p.m.) for 2 wk. No larvae were found on the basal barriers and no secretion trails led to these areas. In contrast, 43 larvae were recovered on the plastic sheeting (86% recovery). Larvae were found at both sampling times during the observation period, indicating that larval dispersal is not synchronized. Not surprisingly, larvae were uniformly located within the drip line of study trees. A small (~2cm) irregularly shaped yellow secretion surrounded each larva, indicating the impact point. The remaining 7 larvae were not recovered and may have succumbed to predation (Christensen et al. 2011).

Freefall of coleopteran larvae in search of suitable pupation sites is a commonly assumed, but rarely observed, pathway for reaching the forest floor (Clark et al. 1998). Selection pressures that may have influenced the evolution of this behavior include reducing the time required to reach pupation sites. Dropping limits energy expended in this effort versus climbing down tree trunks. Expediting larval dispersal to pupation sites also reduces exposure to natural enemies. Although *O. vitiosa* larvae can survive the fall from *M. quinquenervia* canopies, their mortality rates as a result of these events are unknown. It should be noted, however, that dead larvae were not observed on the forest floor during field surveys. These observations also have relevance to the persistence of *O. vitiosa* in *M. quinquenervia* dominated systems of Florida. For example, larvae dropping from trees growing in long hydroperiod wetlands are likely to drown. This explains, in part, why persistent populations do not occur in these habitats (Center et al. 2000).

Summary

The Australian weevil *Oxyops vitiosa* is a biological control agent of the exotic tree *Melaleuca quinquenervia* in Florida, USA. Evidence suggests that the last instar drops from the canopy to the forest floor to pupate in the soil or leaf litter. This dispersal method preempts weevil population persistence in permanently flooded habitats, where some populations of the exotic weed occur. In these habitats, sustained weevil herbivory is dependent upon repeated colonization events.

Key Words: freefall of larvae, leaf litter, *Melaleuca quinquenervia*

Resumen

El gorgojo australiano, *Oxyops vitiosa*, es un agente de control biológico del árbol exótico *Melaleuca quinquenervia* en la Florida, EE.UU. La evidencia sugiere que el último estadio cae desde la copa al suelo para empupar en el suelo o la hojarasca del bosque. Este método de dispersión de la población del gorgojo adelanta su persistencia en hábitats permanentemente inundados, donde algunas poblaciones de la maleza exótica ocurren, entonces el efecto herbivoro sostenido por el gorgojo depende de eventos repetidos de colonización.

Palabras Clave: caida libre de larvas, hojarasca, *Melaleuca quinquenervia*

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